Donc $\varphi_x + \pi - \varphi_F = \frac{\pi}{2} \Rightarrow \varphi_F - \varphi_x = \frac{\pi}{2}$

Or $v = \frac{dx}{dt} \Rightarrow \varphi_v = \varphi_x + \frac{\pi}{2}$

Donc

$$\varphi_F - \left(\varphi_v - \frac{\pi}{2}\right) = \frac{\pi}{2} \Rightarrow \varphi_F = \varphi_v$$

F et V en phase => résonance de vitesse

b- $\omega = \omega_0 = \sqrt{\frac{k}{n}} = 20 rad.s^{-1}$

$f(t) = -h.v(t) = -hV_n \sin(\omega_0 t + \varphi_v)$

Or pour $\omega = \omega_0$ on a $F_m = hV_m$ et $\varphi_F = \varphi_v$

Donc $f(t) = -F_m \sin(\omega_0 t + \varphi_F) = -F(t) = -5\sin(20t)$

$= 5\sin(20t + \pi)$ en N

c- $f(t) = -F(t) \Rightarrow f + F = 0$

$\Rightarrow$ **f et F en opposition de phase**

$\|\vec{f}\| = \|\vec{F}\|$

La force excitatrice compense totalement la force de frottement

d- $P_0 = \frac{RI_m^2}{2}$

Par analogie

$$P = \frac{hV_m^2}{2} = \frac{3}{2}\left(\frac{5}{3}\right)^2 = 4{,}16 \text{ watt}$$

Exercice N°8 :

I-

1°)

a-

* $F(t) = F_m \sin(\omega t + \varphi_F)$

$F_m = 2N$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{\frac{\pi}{6}} = 12 rad.s^{-1}$$

$$\text{à } t = 0 \quad \left.\begin{array}{l} F(0) = F_m \sin(\varphi_F) = 0 \\ \cos(\varphi_F) > 0 \end{array}\right\} \Rightarrow \varphi_F = 0$$

$F(t) = 2\sin(12t)$ en N

* $V(t) = V_m \sin(\omega t + \varphi_v)$

$V_m = 1 m.s^{-1}$

$$\Delta t = \frac{T}{8} \Rightarrow |\Delta\varphi| = \omega \Delta t = \frac{2\pi}{T} \cdot \frac{T}{8} = \frac{\pi}{4}$$

F(t) en avance de phase % av(t)

$\Rightarrow \varphi_F - \varphi_v = \frac{\pi}{4}$ or $\varphi_F = 0 \Rightarrow \varphi_v = -\frac{\pi}{4}$

$v(t) = \sin\left(12t - \frac{\pi}{4}\right)$ en $m.s^{-1}$